Virtual Cosmic Ray Observatory (ViCRO)*

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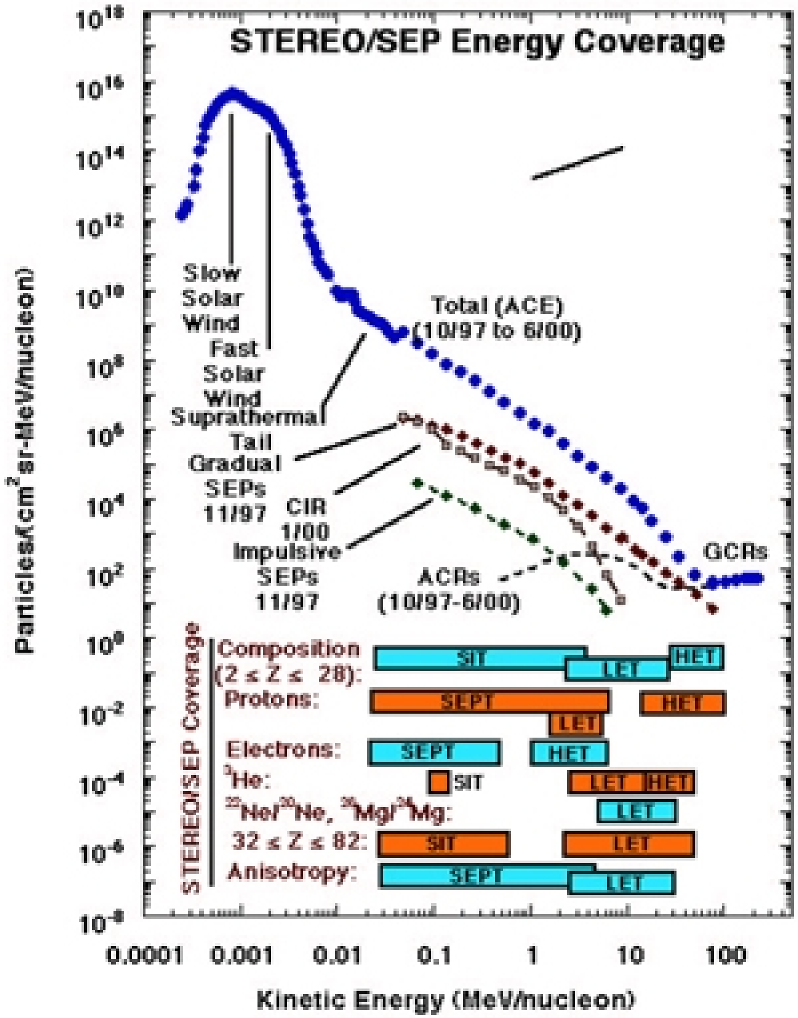
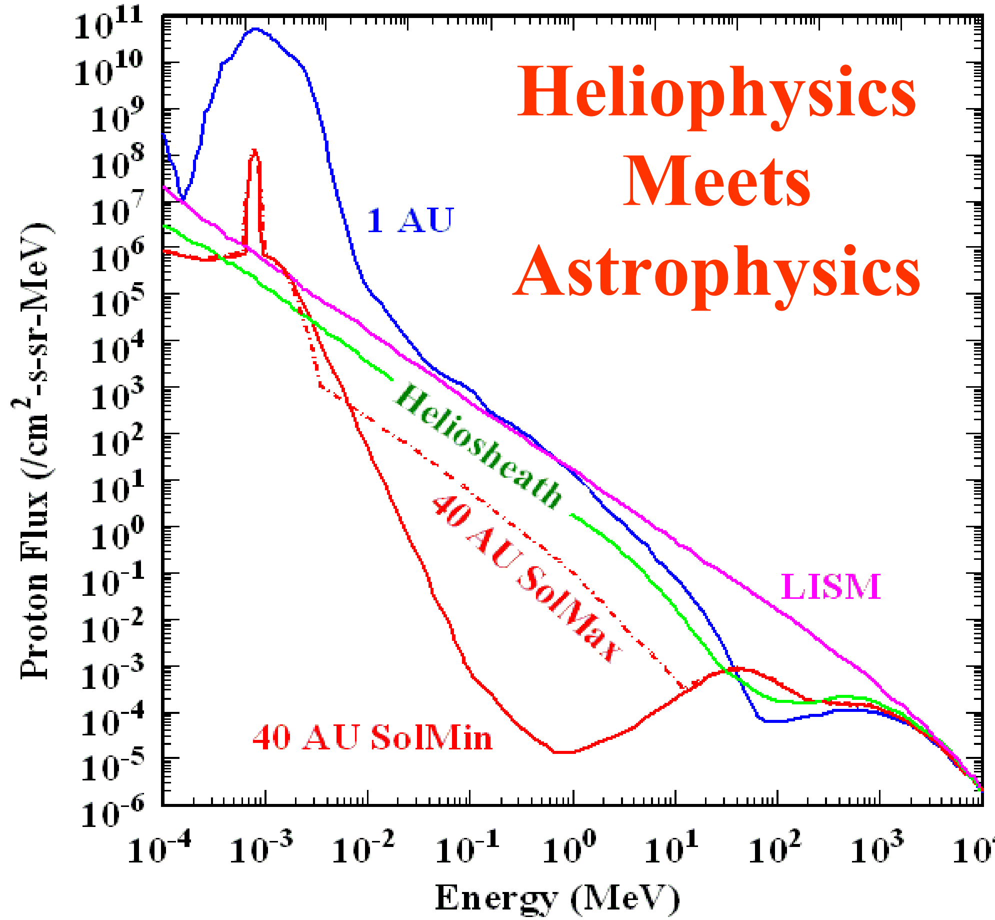
*** To become Virtual Energetic Particle Observatory (VEPO) ?**

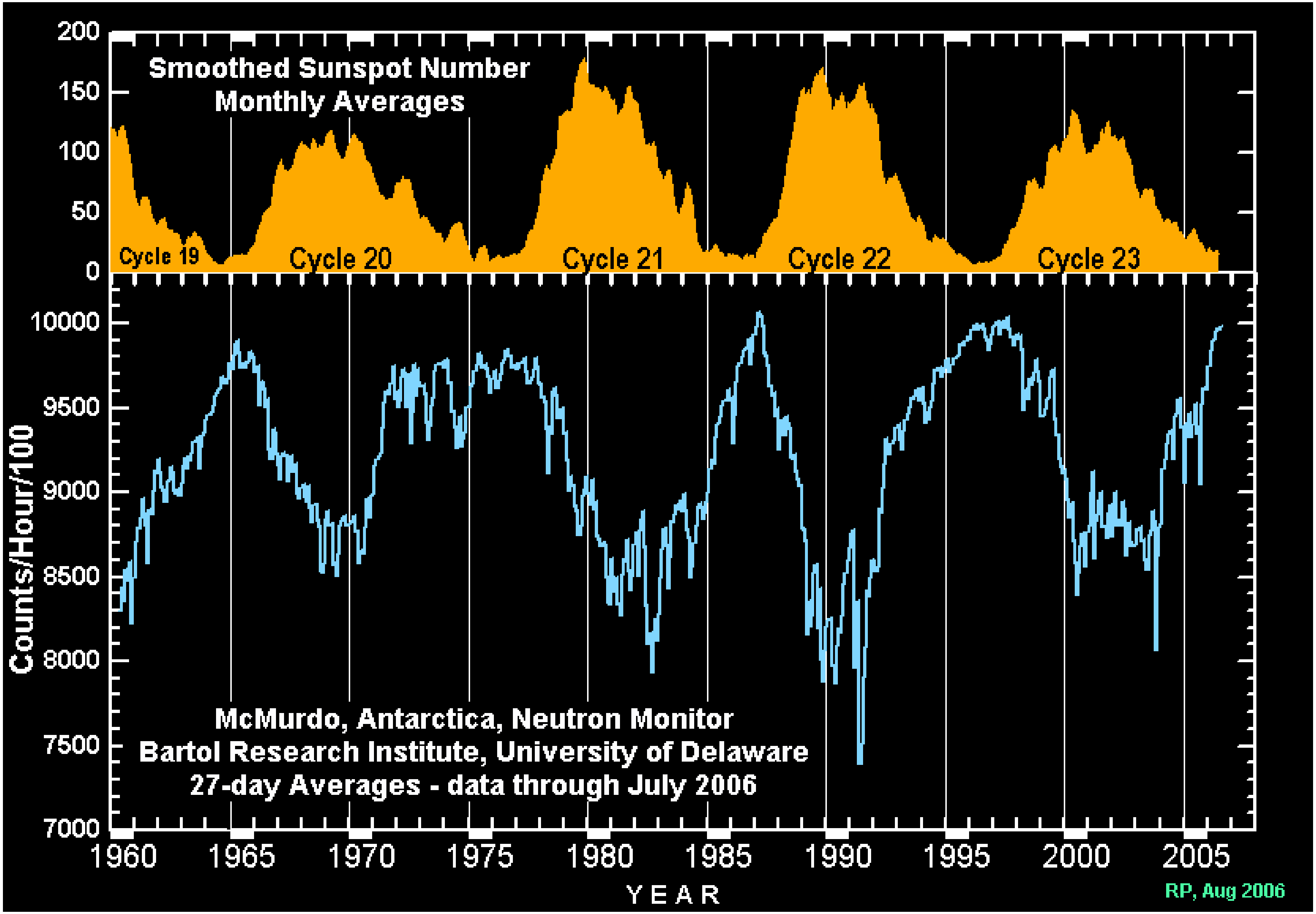
Energetic Particles from Solar, Heliospheric, ISM Sources





ViCRO data set intercalibration could support access to multi-mission, multi-sensor flux spectra

Providing Higher Visibility to Endangered Data Sets



Heliospheric Science Needs High-Energy CR Data !

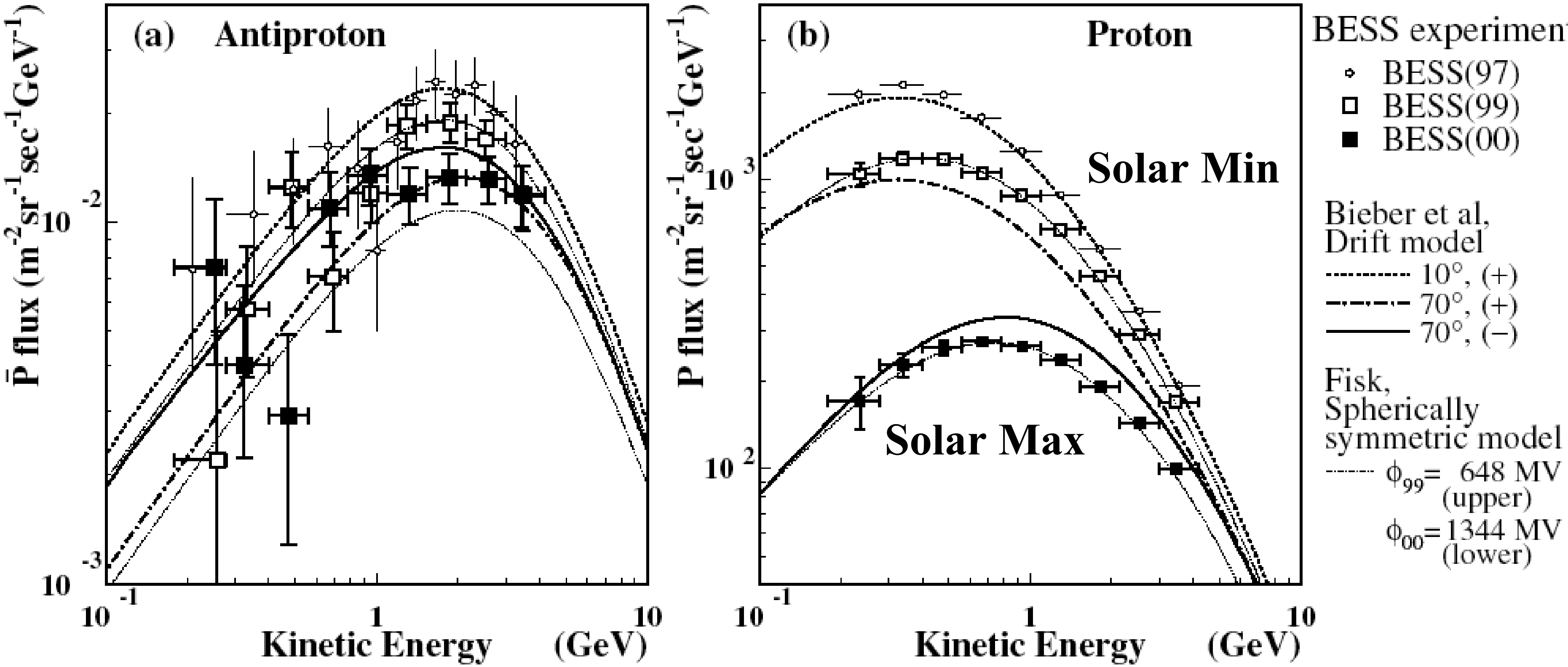


Figure 2-4. (From Asaoka et al., 2002). The (a) antiproton and (b) proton fluxes measured by BESS in 1999 and 2000 together with the previous data in 1997. The curves represent the modulation calculations by a gradient-curvature drift model (Bieber et al., 1999) at periods of 10 or 70 degrees inclination in the heliospheric current sheet, which, respectively, represent solar minimum at positive phase (dashed line), solar maximum at positive phase (dash-dotted line), and solar maximum at negative phase (solid line). The dotted curves represent the calculations by the spherically symmetric model (Fisk, 1971).

ViCRO Overall Objectives

Provide common view of cosmic ray instrument and related ancillary data from NASA and affiliated international Heliospheric Network spacecraft. ***Expand to ground-based <u>and suborbital</u> data sources.***

Facilitate data comparison with respect to heliospheric location of the platform, and with respect to time, energy, and other parameters of local measurements. ***Enable intercalibration of multisensor data.***

Serve data and collaborative research needs of the U.S., and affiliated international, cosmic ray communities to support cross-disciplinary research on sources, acceleration, transport, and surface & atmospheric interaction effects of cosmic rays. ***Support CR models.***

GSFC-APL-UNH-FTech Partnership will integrate expertise in cosmic ray science with supporting data technology of the NASA-supported Virtual Heliospheric Observatory (VHO) and the Space Physics Data Facility (CDAWeb, OMNIWeb/COHOWeb, SSCWeb)

What is a Virtual Observatory, according to NASA?

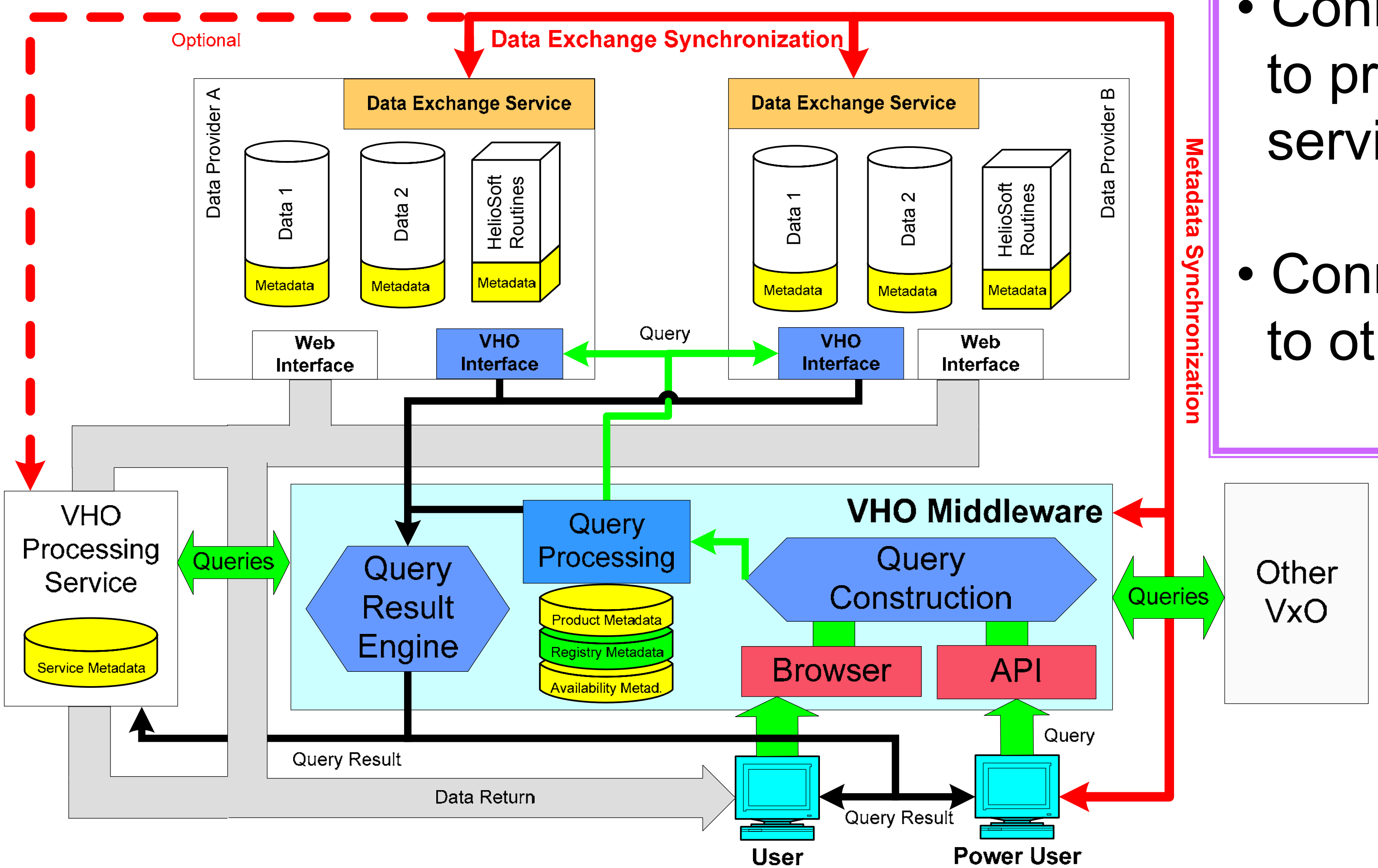
"A Virtual Observatory (VO) is a suite of software applications on a set of computers that allows users to uniformly find, access, and use resources (data, software, document, and image products and services using these) from a collection of distributed product repositories and service providers. A VO is a service that unites services and/or multiple repositories."

The Seven Pillars of Wisdom* for ViCRO Functions as a VxO

1. Coordinated Discovery and Access
2. Understanding of Data Needs
3. Standards and Metadata
4. APIs and Web services
5. Value Added Services
6. Ancillary Data Access
7. Usage Assessment and Provenance Protection

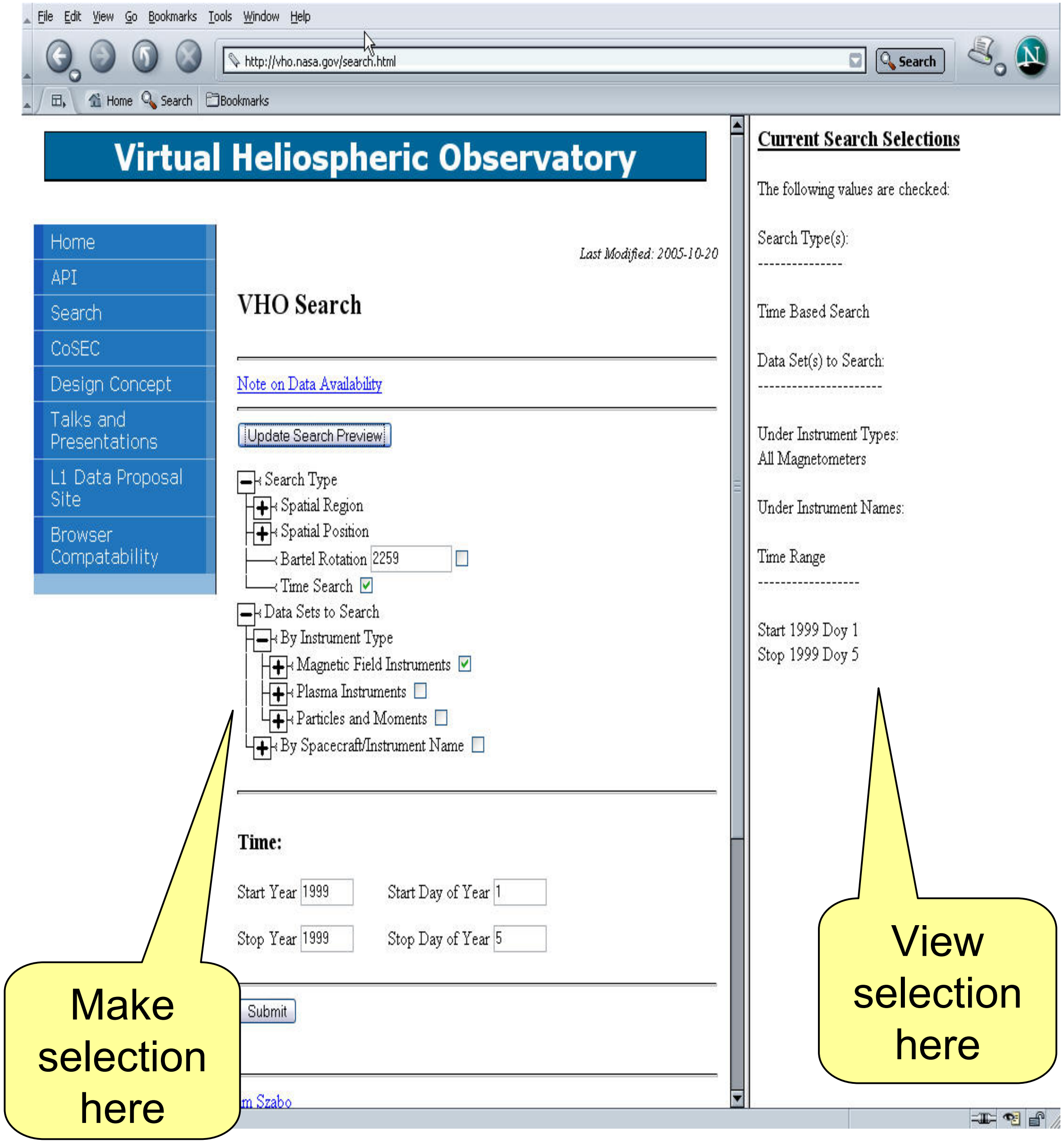
***Wisdom hath builded her house, she hath hewn out her seven pillars (Proverbs 9:1)**

- **ViCRO will mainly utilize existing middleware and APIs of the Virtual Heliospheric Observatory (VHO)**
- **“VxO in a Box” software could be used by other VxOs**



- Connection to processing services.
- Connection to other VxOs

Data can be searched for by the following ways:



Time
- Date/Time
- Bartel/Carrington Rot.

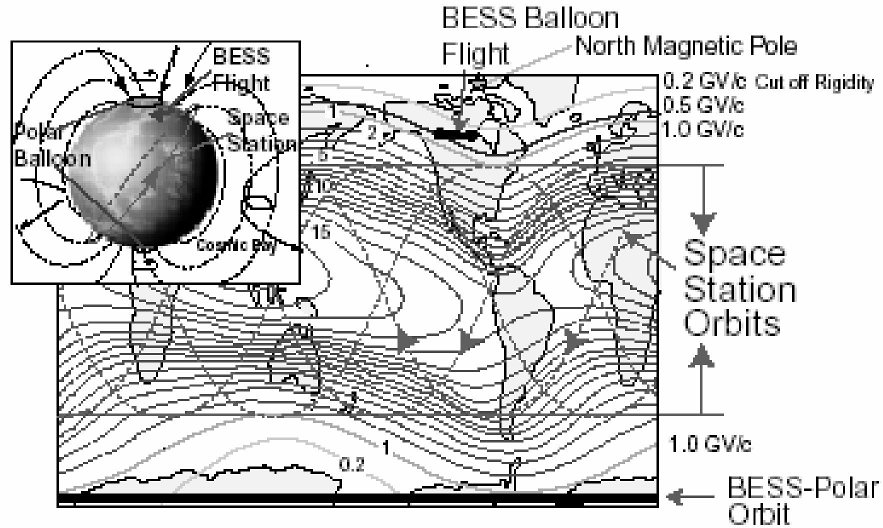
S/C Location
- GSE/GSM/HGI coord.
- Region name

Measurement Type
- e.g., magnetic field, thermal plasma, energetic particles

Table 1. Cosmic Ray Data Environment for ViCRO Access

S/C	Instrument	Measurements*	Max. Res.	Time Span*	Provider
ACE	EPAM	ions 0.05-50 MeV, e	5-min	1997 – Present	FTECH
	SEPICA	ions 0.1 - 5.0 MeV/n	120-s	1997 – 2005	ASC
	ULEIS	Ions 0.02 – 14 MeV/n	1-hr	1998 – Present	ASC
	SIS	ions 5 – 150 MeV/n	256-s	1997 – Present	ASC
	CRIS	ions 100 – 500 MeV/n	1-hr	1997 – Present	ASC
CASSINI	MIMI	ions 0.015 – ≥1 MeV/n, e	(Cruise)	1999 – 2004	PDS
GALILEO	EPD	ions 0.02 – 100 MeV, e	(Cruise)	1989 – 1994	PDS
	HIC	ions 2.4- 50 MeV/n	(Cruise)	1989 – 1994	PDS
HELIOS 1,2	E6-Kiel	p, He 1.3 – ≥45 MeV/n, e	1-hr	1974 – 1983	NSSDC
	E7-Trainor	p, ions 0.12 MeV – ≥250 MeV/n	1-hr	1974 – 1984	NSSDC
	E8-Keppler	p, 0.08 – 1 MeV, e	1-hr	1974 – 1980	NSSDC
IMP-8	CPME	p, 0.3 – 500 MeV, He, e	20-s	1973 – Present	FTECH
	GME	p, 0.05 – 500 MeV, ions, e	Full-Res.	1973 - Present	SPDF
	CRNC	p,ions 0.5 – 10^2 MeV/n, e	15-min	1973 – Present	NSSDC
MESSENGER	EPPS	ions 0.01 – 5 MeV, e	(Cruise)	2004 – Present	PDS
NEW HORIZONS	PEPSSI	p, ions 0.03 – 1 MeV,e	2-s	2006 - Present	PDS
PIONEER 10,11	CPI	p, 0.3 – ≥68 MeV, ions, e	15-min	1972 – 1992	NSSDC
	CRT	p, 0.05 – 200 MeV, ions, e	6-hr	1972 – 1994	NSSDC
	GTT	p, 7 – ≥78 MeV, e	15-min	1972 – 1996	NSSDC
	TRD	p, 0.15 – ≥80 MeV, e	30-min	1972 – 1993	NSSDC
SOHO	COSTEP	p, He 2 – 60 MeV/n, e	5-min	1995 – 2002	NSSDC
	ERNE	p, He 2 – 128 MeV, e	1-min	1995 – 2000	NSSDC
STEREO A,B	IMPACT	p, 0.02 – 100 MeV, ions, e		2006 – Present	SSC
ULYSSES	COSPIN	p, ions 0.5 – 100 MeV/n, e	10-min	1990 – Present	UDS
	EPAC	p, 0.5 – 1.5 MeV, ions, e	Full-Res	1990 - Present	UDS
	HISCALE	ions, 0.05 – 5 MeV, e	Full-Res	1990 – Present	FTECH
VOYAGER 1,2	LECP	ions 0.015 – 150 MeV, e	1-hr	1977 – Present	APL
	CRS	He 1.8 – 500 MeV/n, p, ions, e	6-hr	1977 – Present	SPDF
WIND	EPACT	p, 1.4 – 120 MeV, ions, e		1994 – Present	TBD

ViCRO Data Environment Could Expand to Cosmic Ray Balloon Experiments



Balloon-borne Experiment with a Superconducting Spectrometer (BESS)

BALLOON FLIGHTS

The balloon experiment has been successfully carried out since 1993. The spectrometer was launched from Lynn Lake, Manitoba, Canada, every summer, and seven flights have been successful (Anraku et al., 1996; Yamamoto et al, 1998; Yoshida, 2000). It stayed at an altitude of 35 km with a residual pressure of ~5 mb. Those flight conditions are summarized in Table 1.

Table 1. Progress of the BESS balloon flights in Canada.

Year	unit	93	94	95	97	98	99	2000
Floating time	[hours]	17.5	17.0	19.5	20.5	22	34.5	44.5
Observation time	[hours]	14	15	17.5	18.3	20.0	(2.8*)+31.3	(2.5)+32.5
Event recorded	[events]	4.0	4.2	4.5	16.2	19.0	(2.3*)+16.8	‡(2)+15
Data size	[GB]	4.5	6.5	8.0	31	38	41	38
TOF time res.	[ps]	300	300	100	75	75	75	75
Silica-aerogel index					1.032	1.020	1.020	1.020
Anti-proton observed		6	2	43	415	384	> 650	TBD
Anti-p. en.-range	[GeV]	0.18 ~0.5	0.18~0.5	0.18~1.5	0.18~3.6	0.18~4.2	0.18~4.2	0.18~4.2
Anti-He/He limit		2.2×10^{-5}	4.3×10^{-6}	2.4×10^{-6}	1.4×10^{-6}	1.0×10^{-6}	0.8×10^{-6}	TBD

* (data taking also during ascending)

BESS-Polar
2004, 2007+
Antarctic Flights
E_p > 100 MeV

So You Want to be a NASA Spacecraft Mission PI ?

From 2007 SMEX Draft Announcement of Opportunity

- A mission PI must have served for at least two years previously as the PI, the Deputy PI, the Project Scientist (PS), the Deputy PS, PM, or Deputy PM **on a qualifying space project**.
- A space project is one that goes into the space or **near-space environment**.
- Space projects include suborbital projects (sounding rockets, **scientific balloons**), orbital projects, and deep space projects.
- For the purpose of this AO, a **suborbital experiment that reached greater than 100K feet** can be considered to have gone into “space”.

Heliophysics Data Environment Policy Requirements

- **Mission Proposal or Science Definition Report – includes data management plan**
- **Project Data Management Plan (PDMP) – begin at PDR and finalize for CDR**

  Mission's data requirements and how the mission's data system will be implemented in order to meet the Mission's requirements. One of requirements on the mission data system will be the **production and open distribution of independently useable data**. Among other things, the PMDP should include **how the mission data team will provide links to the larger data environment, including Virtual Observatories, and long term archives.**
- **Memorandum of Understanding (MOU)**

  Brief executive agreement for data transfer with NASA archive or other facility receiving data as specified in PDMP and/or other detailed technical documents
- **Launch**

  The **mission's data system as laid out in the PDMP will be operational** and ready for production and distribution of the mission's science data once initial testing and calibration have been carried out.
- **Senior Review (at beginning and for updates of extended mission)**

  The mission will submit its initial Mission Archive Plan (MAP) that will indicate the steps that the mission needs to implement its science data archive.
- **Mission Termination**

  The **steps in the MAP should be complete** and the **data should be ready to transition to a Resident Archive (RA), multi-mission data center, or other depository under auspices of the NSSDC. Final archive at RA termination is NSSDC.**

See example PDMPs and MOUs at nssdc.gsfc.nasa.gov

Balloon Program Data Suggestions

- Accept that data management planning in the NASA sub-orbital program environment is now integral to PI and team training for spaceflight missions
- Define types of data products potentially useable by other experiment teams doing related science and by the relevant research communities – form discipline working groups
- Move toward requirement for data management plans connecting to NASA archives in new experiment proposals
- Define post-flight data restoration projects for selected experiments, e.g. BESS flight series
- Negotiate with responsible NASA archives for final deposition of data products
- Consider BESS/BESS Polar flight series as prototype project for implementation of data management processes in regard to heliospheric science applications
- Identify funding opportunities to make these things happen in timely manner to train personnel for spaceflight missions